REMARKS

I. Introduction

In this Response, Applicants amend claims 2, 5, 8, 9, 13, and 15, cancel claims 1, 4, 7, 12, and 20, and address the Examiner's objections and rejections. Support for the amendments to the claims can be found throughout the Application, including paragraphs 15-18 of the Published Application. Amendments to the claims are being made solely to expedite prosecution and do not constitute an acquiescence to any of the Examiner's objections or rejections. Applicants reserve the option to further prosecute the same or similar claims in the present or a subsequent application. Applicants' silence with regard to rejections of dependent claims constitutes recognition by the Applicants that the rejections are moot based on Applicants' Amendment and/or Remarks relative to the independent claim from which the dependent claims depend. Upon entry of this amendment, claims 2-3, 5-6, 8-11, 13, and 15-19 will be pending.

II. The Office Action

Claims 2, 9 and 12 were rejected because of informalities.

Claims 1 and 4 were rejected under 35 U.S.C. § 101 as not drawn to statutory subject matter. Claims 8, 12-13, and 20 were rejected as containing limitations with insufficient antecedent basis. Claims 12-13 and 20 were also rejected as indefinite for claiming the Abrams and Lloyd quantum method without reciting any steps involved in the method. Claim 14 was rejected as indefinite. Claims 2-7, 9 and 15 were rejected under 35 U.S.C. § 112, second paragraph, as indefinite. Claim 20 was further rejected as indefinite.

III. The Claim Objections

Claims 2 and 9 have been amended according to the Examiner's suggestions to overcome the formalities objections. Claim 12 has been cancelled. Withdrawal of the objections is respectfully requested.

IV. Claim Rejections -- 35 U.S.C. § 101

Claims 1 and 4 have been cancelled. The rejections of claims 1 and 4 have been rendered moot by the cancelation of those claims.

V. Claim Rejections -- 35 U.S.C. § 112, 2nd paragraph

Claims 12 and 20 have been cancelled. The rejections of those claims have, therefore, been rendered moot. Claims 8 and 13 have been amended to correct the lack of antecedent basis. Withdrawal of the rejection of claims 8 and 13 is respectfully requested.

Claim 14 was rejected as indefinite, as containing the term "classically." (*See* Office Action, at page 3). Applicants hereby submit a declaration from inventor Dr. Anargyros Papageorgiou. According to the declaration, quantum computing is a computation paradigm based on the idea of using quantum mechanics to perform computations. This is in contrast to ordinary or conventional or traditional computers, which perform computations based on classical physics. (*See* Papageorgiou Declaration at ¶ 5).

Classical computing is a term used in computer science to distinguish computations that are performed by classical or conventional computers, in contrast to computations performed by quantum computers. The term classical algorithm is used to describe an algorithm for a computation that is to be carried out on classical or conventional computer, as opposed to the term quantum algorithm that describes a computation to be carried out on a quantum computer. (*See* Papageorgiou Declaration at ¶ 6).

The term "classically" is a term that is generally understood in computer science to describe computation performed using a classical or conventional computer. (*See* Papageorgiou Declaration at ¶ 7). Accordingly, a person having ordinary skill in the art would clearly understand that the limitation "wherein the first eigenvector is obtained classically," means the first eigenvector is obtained using classical and conventional computers.

Claims 4 and 7 have been cancelled. The rejections of those claims have, therefore, been rendered moot.

The Office Action at page 3, recites:

> "Claim 2 recites 'a method for computing an approximation of a vector' comprising 'storing an approximation' and 'appending a qubit to the register'; it is unclear how storing an approximation and appending a qubit to the register are computing an approximation of a vector." (*See* Office Action at page 3)

Applicants respectfully submit that this is a misrepresentation of claim 2. Claim 2 recites "[a] method for computing an approximation of a vector, comprising storing a *first* approximation of the vector in a quantum computer register, and appending a qubit to the quantum computer register that stores the first approximation of the vector." (emphasis added).

Therefore, the approximation is computed from a first approximation and from appending a qubit to the register that holds the approximation. Claim 3 further recites the step of "performing a Hadamard transformation on the appended qubit."

The Office Action at page 4, recites "[a]s per claim 5, it is unclear what vector is stored and how appending two qubits to the vector prepare an initial state." (*See* Office Action at page 4).

Applicants respectfully submit that claim 5 relates to preparing a state of a quantum computer. The state of a quantum computer can be stored in a quantum computer register. Claim 5 is not concerned with a particular value of the vector stored in the quantum computer register. Claim 5 recites a method that recites "storing a vector in a quantum computer register," "appending at least two qubits to the vector in a quantum computer register," and "performing a Hadamard transformation on the appended at least two qubits." Claim 6 further recites that the "at least two of the appended qubits are in the state |0>."

Applicants respectfully submit that claims 2-3 and 5-6 are not indefinite.

Claims 9 and 15 have been amended to address the rejections under 35 U.S.C. § 112.

Withdrawal of the rejections under 35 U.S.C. § 112 is respectfully requested.

VI. Claim Rejections – 35 U.S.C. § 102

Claims 1-10 and 13-18 were rejected under 35 U.S.C. § 102 by the article entitled "How Behavior of Systems with Sparse Spectrum Can Be Predicted on a Quantum Computer," by Ozhigov ("Ozhigov").

Amended claim 2 recites a method for computing an approximation of a vector, comprising "storing a first approximation of the vector in a quantum computer register" and "appending a qubit to the quantum computer register that stores the first approximation of the vector."

Ozhigov describes a method of predicting the behavior of systems with sparse spectrum on quantum computers (Title and Abstract). In Ozhigov, "the memory [is] divided into the main part x of n qubits and the ancilla a of $p \leq n$ qubits: $|x,a>$, $M = 2^p$." (*See* Ozhigov, at p. 676, lines 26-28) (emphasis in original). Then Ozhigov sets $WH|x,a>$ as:

"$WH \mid x,a >= \frac{1}{\sqrt{M}} \sum_{s=0}^{M-1} (-1)^{as} \mid x,s >$. It is the WH [Walsh-Hadamard] transformation applied to the ancilla." (*See* Ozhigov, at p. 676, lines 30-31) (emphasis added).

Ozhigov does not teach or disclose appending a qubit to the quantum computer register that stores the first approximation of the vector. Ozhigov discloses dividing the register in a main and an ancilla part. Therefore, claim 2 is considered allowable over Ozhigov.

Claims 5, 8, 9, 13, 15, and 18

Independent claims 5, 8, 9, 13, 15, and 18 recite similar limitations to the ones recited in claim 2. For example, claim 5 recites "appending at least two qubits to the vector in a quantum computer register." Claim 8 recites "appending at least two qubits in the state |0> to the first eigenvector approximation." Claim 9 recites "appending at least two qubits to the eigenvector in the quantum computer register." Claim 13 recites "appending at least two qubits in a second

quantum register to the first eigenvector." Claim 15 recites "means for appending at least two qubits to the first eigenvector in the quantum register." Claim 18 recites "means for appending at least two qubits in a second quantum register."

Accordingly, Applicants respectfully submit that claims 5, 8, 9, 13, 15 and 18 are allowable over Ozhigov for at least the reasons discussed above in connection with claim 2, and therefore respectfully request the allowance of these claims.

Dependent Claims

Claims 3, 6, 10, 14, 16, and 17 each depend from one of independent claims 2, 5, 8, 9, 13, 15, and 18, are allowable for at least the same reasons that their corresponding independent claims are allowable. Applicants respectfully request the allowance of the same.

VII. Claim Rejections – 35 U.S.C. § 103(a)

Claims 11-12 and 19-20 were rejected under as 35 U.S.C. § 103(a) obvious over Ozhigov in view of the article entitled "A Two-grid Discretization Scheme for Eigenvalue Problems," by Xu et al. ("Xu"). Claims 12 and 20 have been cancelled. The rejections of those claims have been rendered moot by the cancellation of those claims. Claims 11 and 19 depend from independent claims 9 and 18, respectively, and are considered allowable for at least the same reasons that their corresponding independent claims are allowable over Ozhigov.

Xu describes a two-grid discretization scheme for solving eigenvalue problems. (Title and Abstract). Specifically, according to Xu, the solution of an eigenvalue problem on a fine grid can make use of to the solution of an eigenvalue problem in a much coarser grid. (Abstract). Xu does not remedy the shortcomings of Ozhigov with regard to appending a qubit to the end of a value stored a quantum register as recited in claims 11 and 19. Accordingly, Applicants respectfully submit that claims 11 and 19 are allowable over the cited references and respectfully request the allowance of claims 11 and 19.

VIII. Conclusion

The foregoing demonstrates that claims 2-3, 5-6, 8-11, 13, and 15-19 are patentable. This application is therefore in condition for allowance. Reconsideration and prompt allowance are accordingly respectfully requested.

IX. Authorization

The Commissioner is hereby authorized to charge any additional fees which may be required for this Amendment, or credit any overpayment, to Deposit Account No. 08-0219, under Order No. 0019240.00171US3. Applicants herewith submit the fee for a two month extension of time. No other fees are believed due with this submission. However, if a fee is due, the Commissioner is authorized to charge any fee or credit any overpayment to Deposit Account No. 08-0219.

Respectfully submitted,

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